in the middle or from the end. This is no empty boast, for without wishing to depreciate a thinker who is evidently an earnest man, we cannot call his book anything but a collection of aphorisms.

Some Pages of Levantine History. By the Rev. H. T. F. Duckworth. Pp. iv+149. (London: Alexander Moring, Ltd., n.d.) Price 3*s.* 6*d.* net.

PROF. DUCKWORTH commends his book "to those of his countrymen who have either made, or intend to make, a pilgrimage to the holy places of Christian and Classical Antiquity," and it should certainly be of service to them. As he was formerly assistant chaplain representing the Eastern Church Association in Cyprus, he writes from first-hand knowledge in many of his chapters. The text is illustrated with several good plates.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE *No notice is taken of anonymous communications.]*

Root Action and Bacteria.

MR. SPENCER PICKERING'S letter on the effect of soil sterilisation on the growth of apple trees (June 6, p. 126) is of interest in connection with experiments which have been made by Dr. Francis V. Darbishire and myself, and described in a paper read last year before the chemical section of the British Association. We find that most plants grow much better in heated than in unheated soils.

That the productiveness of a soil can be increased by heating was shown in 1888 by Frank, and has since been confirmed by other investigators besides ourselves. We have not yet been able completely to account for it. There is, beyond question, an increase in the total activity of the soil microorganisms; this is shown by the increased absorption of oxygen. There is also evidence that some chemical change takes place. Mustard grown in heated soil takes up a larger amount of nitrogen and of phosphorus, indicating an increased "availability" of some of the compounds of these two elements. One of our experiments gave the following results:—

		Yield of mustard in grams		Percentage composition of dry matter		
		Fresh weight	Dry weight	N	P_2O_5	K_2O
Heated soil	(*a*)	229·59	26·14	4·26	2·39	4·34
	(*b*)	226·15	24·04	4·80	2·01	5·07
Unheated soil	(*a*)	84·60	15·70	2·53	1·07	4·11
	(*b*)	88·70	16·05	2·09	0·92	4·29

Further, it is easy to show that heating increases the solubility both of the organic and of the inorganic matter in the soil. The actual change that takes place can only be ascertained when something more is known of the proximate constituents of the soil, and especially of the ill-defined colloidal bodies collectively known as humus.

The case is somewhat more complicated if the plant depends for part of its food on the activity of organisms which have been killed during the heating process. The increased "availability" of the plant food in the soil may or may not counteract the loss of the special organism; leguminous plants, and trees dependent on mycorrhiza, may therefore be expected to give irregular results.

A further complication may arise if the amount of calcium carbonate in the soil is insufficient. In certain circumstances humus is known to decompose and form bodies which, in absence of calcium carbonate, are injurious to plants. There is no evidence that a similar change does not take place on heating; on the contrary, one of Schulze's experiments (*Landw. Versuchs. Stat.*, 1906, lxv., 137) seems to show that it does. He found that heated pasture soil deficient in calcium carbonate gave a poorer crop of mustard than did the unheated soil, but on adding calcium carbonate the difference in crop disappeared. So far we have always worked with soils containing 3 per cent. or more of this substance, and no depressing effect has been observed, but it would be interesting to know how much was present in Mr. Pickering's soil. Unless there happened to be sufficient, the retardation in growth which he observed may well be due to some injurious body formed by heating the soil rather than to the absence of particular organisms.

EDWARD J. RUSSELL.

South-Eastern Agricultural College, Wye.

Unscientific Administration.

MAY I be allowed to offer a few words of comment on one point raised by Prof. Ronald Ross in his article appearing in this week's NATURE? No one can read his indictment of the Indian official attitude towards science without feeling that another voice crying in the wilderness is warning our administrators and governing classes of the dangers that await an unscientific nation that persists in the error of its ways. In explaining the cause of the present state of affairs, Prof. Ronald Ross says:—". . . Lastly, it is due to our defective public education." May I amend the phrase by interpolating the words "school and university" between the last two words quoted? For surely it is not the mass of the people who are to blame, but rather those who are directing the affairs of the country. Our governing classes have up till now been mostly educated at public schools and the universities of Oxford and Cambridge. To the latter institutions I will not refer. The Editor of NATURE, Prof. Turner, and Prof. Perry, not to mention the council of the Royal Society and others, have done sterling service to the cause of scientific education in their attempts to stir up public opinion; but, notwithstanding a special memorial from the Royal Society, neither university has as yet, by altering its entrance examination, acknowledged that science forms an integral part in a liberal education.

But with regard to science teaching in public schools, of which I may claim several years' experience, it is not too much to say that the outlook is far from promising. Notwithstanding the fact that governing bodies have voted money, built laboratories, and insisted on a minimum at least of science teaching, not one single public school, using the term in its usual application, has for its headmaster a man scientifically trained. The Naval College at Dartmouth and one or two grammar schools are the exceptions which prove the rule.

As a result of this, no science master can ever hope to get a headmastership, and the best men, therefore, do not enter the teaching profession. I should be far from wishing to assert that headmasters are not, as a rule, anxious to do the best they can for science, although their sympathies are with literary subjects, but they cannot do more than allow facilities for boys to learn science. The great clog to progress lies at the door of the assistant masters, who are as a body decidedly anti-scientific. What science master has not heard the opinion confidently asserted that science is only suited to the minds of a small minority of boys? They cannot and will not admit that it can be made an educational instrument of any moment. Who could not mention cases of clever boys being warned not to "waste their time" over science? Was not Darwin himself publicly rebuked for the same offence when a youth at Shrewsbury School? But if chemistry and physics are useless, biology is positively harmful. I have been told that biology should never be taught to boys, since it must turn their minds towards questions of sex about which they should be kept in perfect ignorance! Finally, it is said that the introduction of "modern" subjects such as science has only brought about mental confusion and stagnation, and the sooner we go back to the old exclusively classical curricula the better.

It is not hard to imagine what will be the attitude of mind towards science if the present generation of officials, against whom Prof. Ronald Ross brings his complaints, are succeeded by those who are now at our public schools and

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ancient universities. Surely it is not asking too much of some of our most distinguished men of science that they will follow in Huxley's footsteps, and once more bring home to our schools and universities the responsibility they are incurring by their attitude towards science in the education of the well-to-do classes.

Eton, June 13. M. D. Hill.

The Rainbow.

In "Poems by Two Brothers," written by the Tennysons, and published in 1827, is a poem called "Phrenology." The following lines occur:—

> "Shall we, with Glasgow's learned Watt, maintain
> That yon bright bow is not produced by rain?
> Or deem the theory but ill surmised,
> And call it light (as Brewster) polarised?"

Can any of your readers kindly tell me (1) what view was held by James Watt about the rainbow? (2) If Brewster was the first to point out that its light is polarised? Brewster states that he observed the fact in 1812. (3) Having regard to the date (1827), what were the most probable sources of information to which the writer of the poem was indebted?

Lord Tennyson kindly informs me that the poem was probably written by Charles Tennyson.

Chas. T. Whitmell.

Invermay, Hyde Park, Leeds, June 5.

The Mass of the α Particle.

Just too late to prevent the publication of my letter of last week, I perceived that the arguments contained in it are valueless. Rutherford's estimation of the number of α particles is based on the assumption that the charge on each of them is ϵ, and cannot be used to prove that proposition. The numbers given only show that the heat energy radiated by radium is approximately equal to the kinetic energy of the α rays, as has been pointed out by Rutherford. I regret that this foolish mistake should have led me to trespass needlessly upon your valuable space.

Norman R. Campbell.

Trinity College, Cambridge, June 14.

Animal Messmates.

While searching for marine animals on January 14, I came across some large specimens of *Ciona intestinalis*, which I kept for some time in a large bottle. After a while I noticed a small worm emerging from the larger or exhalent siphon, which, on examination by a competent authority, proved to be a small example of the nemertine worm *Drepanophorus rubrostriatus* = *Amphiporus spectabilis*, Qtrf. Other worms of the same species afterwards emerged, about ten being observed altogether. The Ciona betrayed no apparent annoyance at the egress or return of the creatures, though it withdrew its siphons at the slightest touch of any foreign objects. This observation seems to be a new instance of "animal messmates," or at any rate of the use of an ascidian's test for purposes of shelter by an active creature.

This has been confirmed on several subsequent occasions by myself and others; in one instance, a small Ciona, from which not fewer, but possibly more, than fifteen worms issued, the creature was so transparent that the worms could be observed moving about in its interior.

Frank S. Wright.

Guernsey, June 10.

Decomposition of Radium Bromide.

With reference to Prof. Porter's note in Nature of June 13 (p. 151) on the odour of bromine detected on opening a sealed tube of radium bromide, it appears that the minimum quantity of bromine that is detectable by smell is between the orders 10^{-8} to 10^{-10} grams per cubic centimetre of air. This result has been obtained by the progressive dilution of a definite volume of bromine vapour. It may be mentioned that the vapour of bromine is just detectable by its odour at the temperature of liquid air.

Alfred C. G. Egerton.

University College, London, June 17.

THE DESTINY OF MAN.[1]

E B Poulton

The present volume contains three essays reprinted from two recent addresses and one article by the author. They have been slightly modified and freely illustrated for the present purpose. The first essay, "Nature's Insurgent Son," was delivered as the Romanes lecture at Oxford in 1905. It traces the history of man and his rebellion against nature, shows that his inevitable destiny is to transform rebellion into conquest, points to the causes of delay and the special responsibility for their removal which belongs to our universities.

The second essay, "The Advance of Science," served as the presidential address to the British Association at York in 1906. It gives an account of man's campaign against nature during the last twenty-five years. It is triumphantly successful in the difficult feat of rendering supremely interesting a brief general account of advance in all the great departments of science.

The third essay, "The Sleeping Sickness," reprinted from the *Quarterly Review*, gives an account of this recent terrible scourge of tropical Africa, and the attempts which have been made to deal with it. This essay is the other side of the picture presented in the second. The latter told of splendid successes in the warfare with nature; the present essay gives a startling example of those haphazard, unintelligent methods which bring terrible disaster upon man.

In attempting to give some account of this arresting and important work in the brief limits of the allotted space, I have thought it best to confine my attention to the central argument founded on man's history, rebellion and destiny. This argument, developed in the first essay, appeals strongly to the imagination, and supplies a powerful motive force which has been wanting in the case of earlier appeals for reform.

"Man is held to be a part of Nature, a product of the definite and orderly evolution which is universal; a being resulting from and driven by the one great nexus which we call Nature. He stands alone, face to face with that relentless mechanism. It is his destiny to understand and to control it."

This statement of man's origin is rightly held to contain no implied degradation—rather the reverse. It is only a superficial and ignorant view which sees in evolution the dominion of "chance." "The conclusion that Man is a part of Nature . . . is in fact a specific assertion that he is the predestined outcome of an orderly—and to a large extent 'perceptible'—mechanism." It was of importance to urge this conclusion again, a conclusion set forth, as the author states, by Tyndall in his presidential address to the British Association at Belfast in 1874, and again stated and admirably illustrated by Huxley in 1887.[2] But the error refuted in 1874 and 1887 was still alive and vigorous in 1905, and there is reason to fear that even now it is not wholly extinct.

The emergence of man—perhaps in Lower Miocene times—is shown to be the grand example of an evolution also witnessed in other animals. In many of the early Tertiary Mammalia, as well as in the ancestors of man, it is probable that mechanical form and function had reached a climax. From this point the struggle was conducted and evolution proceeded on a higher plane, and led to progressive increase in the size and powers of the brain. The author suggests the convincing hypothesis[3] that this sudden growth

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[1] "The Kingdom of Man." By E. Ray Lankester, F.R.S. Pp. xii+191. (London: Archibald Constable and Co., Ltd., 1907.) Price 3*s*. 6*d*. net.

[2] "The Life and Letters of Charles Darwin." Edited by Francis Darwin. Vol. ii., Chapter v., Prof. Huxley on the reception of the "Origin of Species," pp. 100–201.

[3] First published in "Cinquantenaire de la Société de Biologie." Pp. 48–51. (Paris, 1877.)

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